NW Natural (GASCO) site, Portland, OR

Wastes:

The two principle byproducts resulting from the cooling process at manufactured gas plants (MGPs) are coal tar and purifier waste.

1) Coal Tar: Coal tar is a reddish brown to black complex oily DNAPL mixture. It has a very strong odor, similar to mothballs or driveway sealer. Although it is common to use the phrase “coal tar” to describe this material, it is important to note that this name is somewhat misleading. MGP tars are quite fluid, with roughly the same viscosity as vegetable oil, although some may be more viscous, and is slightly more dense than water. Consequently, coal tars are more likely to migrate through soils and appear at different locations from where they were originally leaked or disposed of. Since the density difference between coal tar and water is small, the tar may float for significant periods of time. Where tar has been exposed on the ground surface, it tends to partially solidify. In warm weather, the partially hardened tar can become liquid again and flow across the ground surface. When liquid tar is found on the bottom of water bodies, it is not uncommon to see sheens and balls of tar rise to the water surface when the substrate is disturbed.

2) Purifier Waste: To remove impurities (e.g., sulfur and cyanide) from the gas product, the gas was passed through “purifier beds” made up of either lime or wood chips impregnated with iron fillings. The purifier material would be recycled until it became loaded up with tar and other materials and became unusable. Purifier waste (also referred to as “box waste”) is typically found as a dark mixture of wood chips, has a very strong odor and is often highly acidic. The wood chip mixtures had a tendency to spontaneously ignite if left uncovered on the ground surface. Once exposed at the ground surface, the waste will often develop an iridescent blue color known as “Prussian Blue.” Pieces of solidified tar may be mixed in with the waste, but it is unusual to find liquid tar.

Contaminants:

1) VOCs – BTEX: These contaminants represent a small percentage of the mass of MGP tar. However, these are the most soluble and are thus the most likely to be dissolved in groundwater and migrate off site. These are also the most volatile and are thus the most likely to migrate through subsurface soils as vapors or soil gas.
2) SVOCs – PAHs: The PAH compounds originate from the coal tar and do not readily dissolve in water. Thus, they are not as easily transported in groundwater as the BTEX compounds. With the exception of naphthalene, most of the PAHs also do not readily volatilize and are not readily transported as soil gas. However, PAHs can still migrate significant distances underground because of mobile tars

or emulsions moving through the subsurface. These PAHs do not degrade like petroleum PAHs and are persistent in the environment.

3) Cyanide: Complex cyanide compounds originating from the purifier waste can leach into the groundwater and become mobile.
4) pH: Due the highly acidic nature of purifier waste, the pH of the groundwater can also become highly acidic.

Ideal integrated order of work:

1) Year 1: Bank/beach removal (assumption is that the bank is fully characterized, otherwise, year 1 would involve characterization). Remove product to depth in this area and replace with clean soil. The current plan is to locate the wall further up on the uplands to create a buffer zone for habitat restoration (NRT requirement), but that will leave a wedge of contamination that would be difficult to remove once a wall is installed because it may compromise the integrity of the wall. Likewise, significant contamination on the riverside of the wall will confound long-term monitoring of the wall's effectiveness of containing coal tar migration. Addressing the bank first will create a clean barrier between the upland wall and the river which will assist in future assessment of effectiveness of the upland hydraulic control.
2) Years 1 and 2: Nearshore hydraulic control system. Install a combination of wall and extraction wells to control contaminated upland groundwater and NAPL migration. This system should be over-engineered to ensure full capture. Wall would extend from Siltronic/Arkema property line to NW Natural/US Moorings property line with "wings" that extend up both property boundaries (distance TBD). Depth of the wall would be to -150 MSL or keyed into bedrock, depending on geological substrate. Once nearshore control system is complete, install monitoring wells on both sides of the barrier wall and, if necessary, extraction wells at US Moorings. Monitoring will include hydraulic and water quality and will continue until upland source material is controlled and water chemistry meets ambient water quality criteria or other stated RAOs.
3) Years 3 through 5: Inwater removal/dredging. Removal of product in river sediments (up to the boundary of the bank/beach removal) and/or highly contaminated sediments (removal order will identify the extent of work). A temporary cap will most likely need to be placed in the dredge prism for multiple purposes (e.g., stability of surrounding sediments, habitat, recontamination from upriver sources, etc.) until other significant upstream sources are remediated.
4) Years 1 through 5: Upland remedial investigation. Need to **completely** characterize nature and extent of upland contamination at NW Natural property and Siltronic property (Segments 1, 2 and 3). (See Hathaway paper in Engineering Geology.)
5) Year 6: Install extraction wells outside wall to capture stranded wedge, if necessary. This will depend on the amount of product left behind and the chemistry from the monitoring wells located riverward of the barrier wall.

6) Years 7 through 9: Remove/Treat/Contain source material (coal tar and purifier wastes) in the uplands. It is likely that the remedy will involve some combination of these remedies. Install monitoring wells to ensure capture of source material.